SYSTEMS ANALYSIS PROJECT ADVISORY COMMITTEE

and

MAPPS USERS GROUP

SLIDE MATERIAL

March 19-20, 1986

STATUS

RELEASE 2.0

COOPERATION WITH HONEYWELL

MECHANICAL PULPING

QUALITY MODELING

RELEASE 2.0

ALL CLIENTS USING 2.0

RELEASE 1.0 NOW UNSUPPORTED

RELEASE 2.1 IN PROCESS

RELEASE 2.1

INTERRUPT KEY FOR IBM COMPATIBLE MICROCOMPUTERS

GENERALIZE PHYSICAL PROPERTY INTERFACE

RESTRUCTURED DOCUMENTATION

NEW PROCESS MODULES

KILNO2
ALKOXY
EVAPO2
REFNR2

COOPERATION WITH HONEYWELL

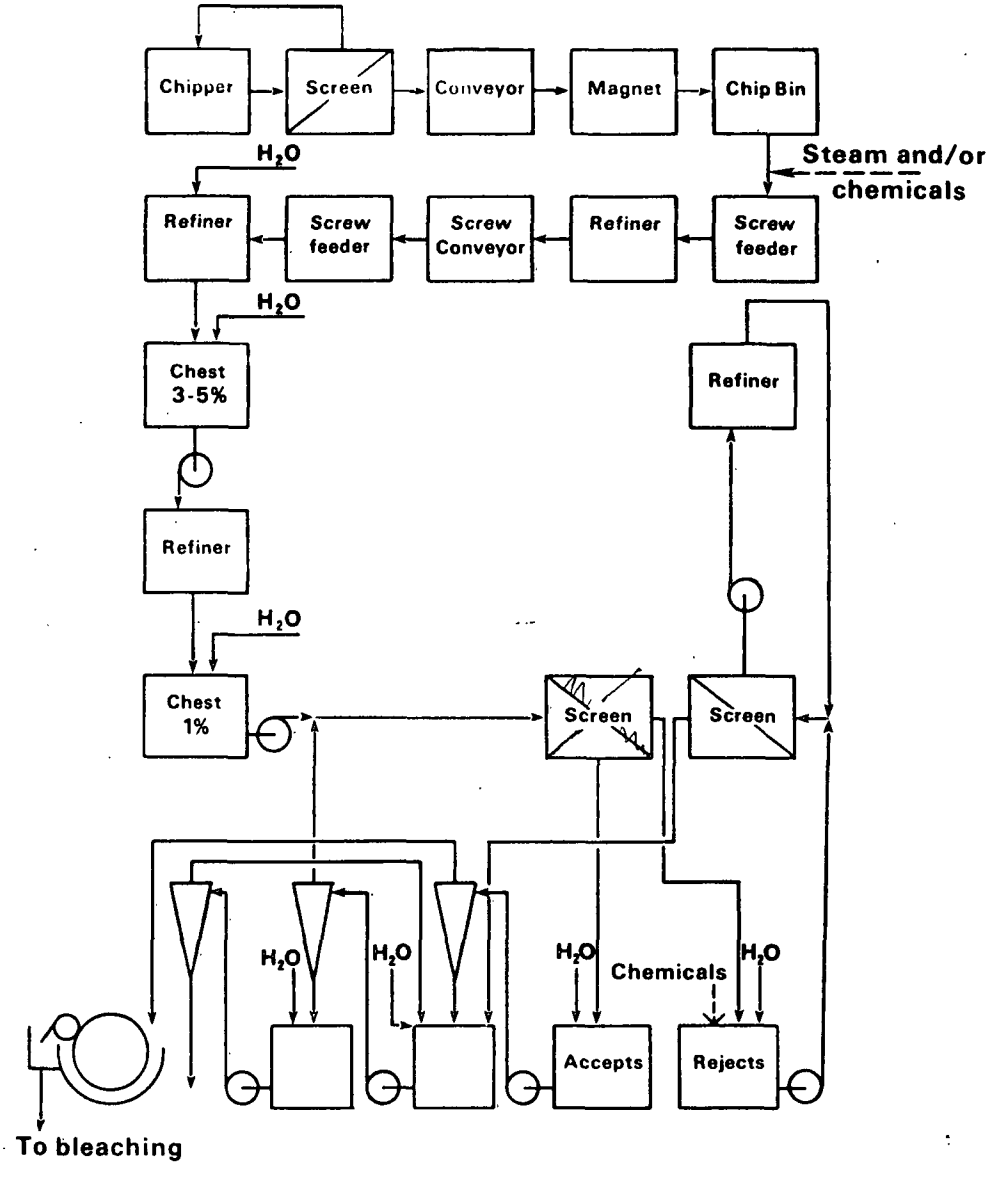
DRIVEN BY HONEYWELL CLIENTS

USE MAPPS ON COMPUTING MODULE OF TDC 3000 SYSTEM

SUCCESSFULLY DEMONSTRATED

MECHANICAL PULPING MODULE FOR MAPPS

G. L. JONES AND M. R. DOSHI



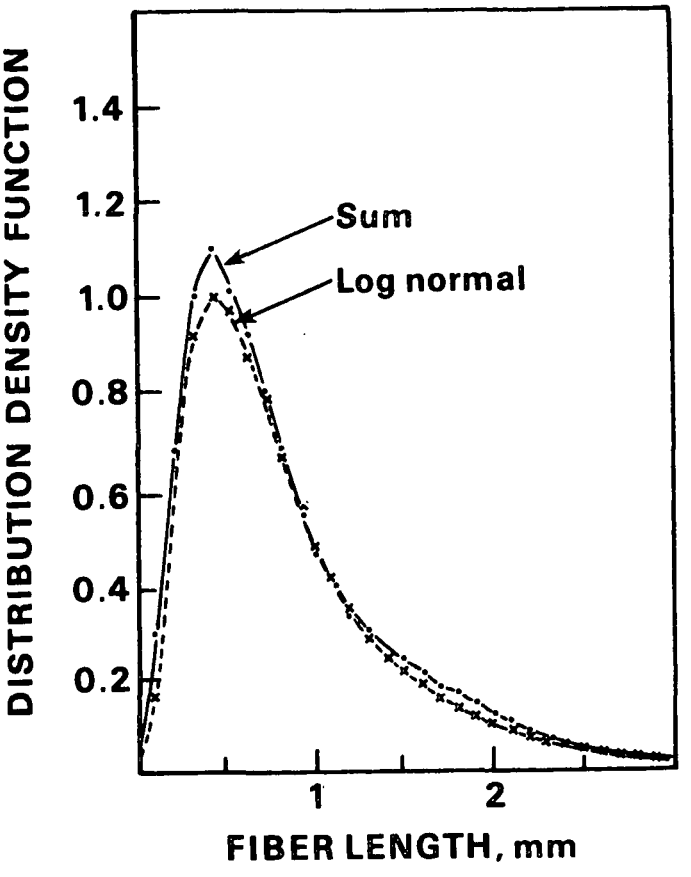
OBJECTIVE

Develop useful and flexible module for the mechanical pulping process.

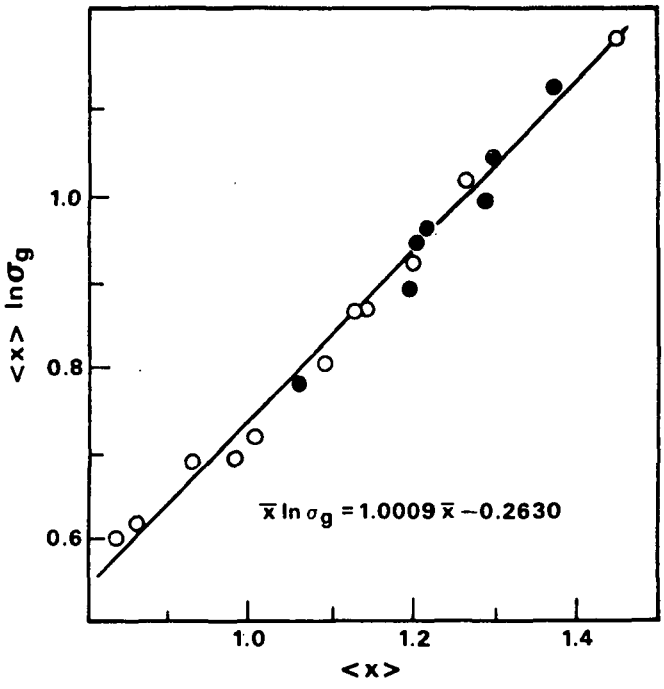
FIBER SIZE DISTRIBUTION

Kinetic theory (Yan)

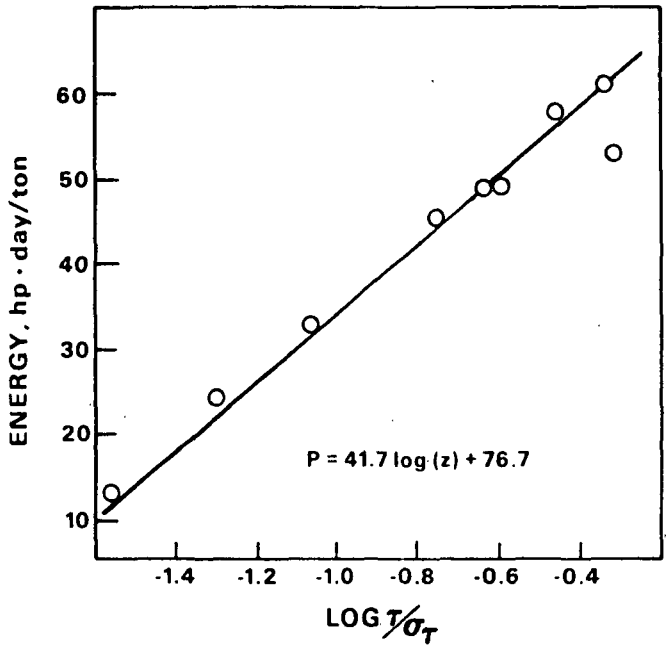
$$f_1(t) = \frac{1}{\sqrt{2\pi}\,\sigma_t} \exp\left[-\frac{(t-\tau)^2}{2\,\sigma_t^2}\right]$$

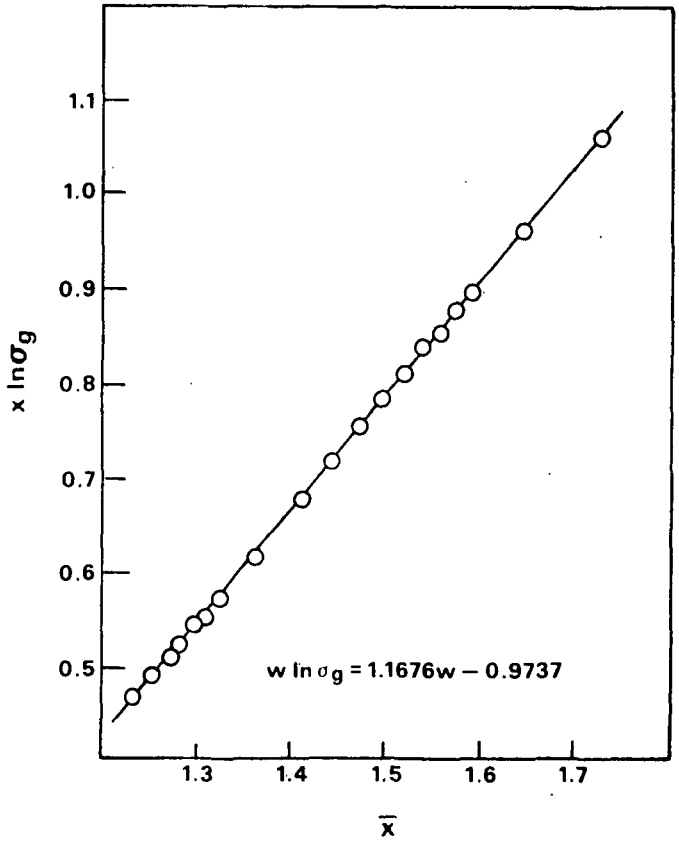


$$f(x) = \frac{1}{\sqrt{2\pi}\ \ln(\sigma_g)} \exp\left[-\frac{(\ln x - \ln xg)^2}{2\ (\ln \sigma_g)^2}\right]$$



$$z = \frac{\tau}{\sigma_t} = \ln \left[\frac{\bar{x}_1 - 0.263}{\bar{x}_2 - 0.263}\right]$$


ENERGY, hp · day/ton
60
50
40
30
20
10
P = 41.7 log (z) + 76.7
-1.4
-1.2
-1.0
-0.8
-0.6
-0.4
LOG τ/σ_τ


x lnσ_g
1.1
1.0
0.9
0.8
0.7
0.6
0.5
w ln σ_g = 1.1676w − 0.9737
1.3
1.4
1.5
1.6
1.7
$\overline{x}$

- Above results valid for softwoods
- Adjust x and w for hardwoods using results of Jan-Erik Leolin
- Allow user to override parameters

SURFACE AREA DEVELOPMENT (EDWARDS & STRAND)

Chip Refiner K Factor

$$K_0 = 1.54 \exp[P(0.123 - 0.0237C)]$$

Secondary Refiner K Factor

$$K = K_0 \exp\left[\left(-0.598 + \frac{0.088P}{K_0} - 4.99\, K_0\, C\right)P\right]$$

$$S_1 = 1 - \frac{1}{K} \ln\left(\frac{L_1}{2.40}\right)$$

$$S_t = 1 - \frac{1}{K} \sum_i X_i \ln\left(\frac{L_i}{2.40}\right)$$

CANADIAN STANDARD FREENESS SUBMODEL
(Jensen, et al.)

$$CSF = 41.7\ M^{1.375}\ p^{-0.625}$$

$$CSF = 119\ M^{1.313}\ p^{-0.823}$$

VARIOUS ENERGY COMPONENTS IN MECHANICAL PULPING
(from Marton)

P → { Idling loss, P-E
Energy applied to chips, E

↓

Separation of fibers, E_S

Development of properties, E_d

↓

Developing surface area < delimination / fibrillation

Improving flexibility

Generating fines

Cutting fibers

$$E = E_d + aS^k$$

POWER CONSUMPTION AND DISTRIBUTION
(Marton)

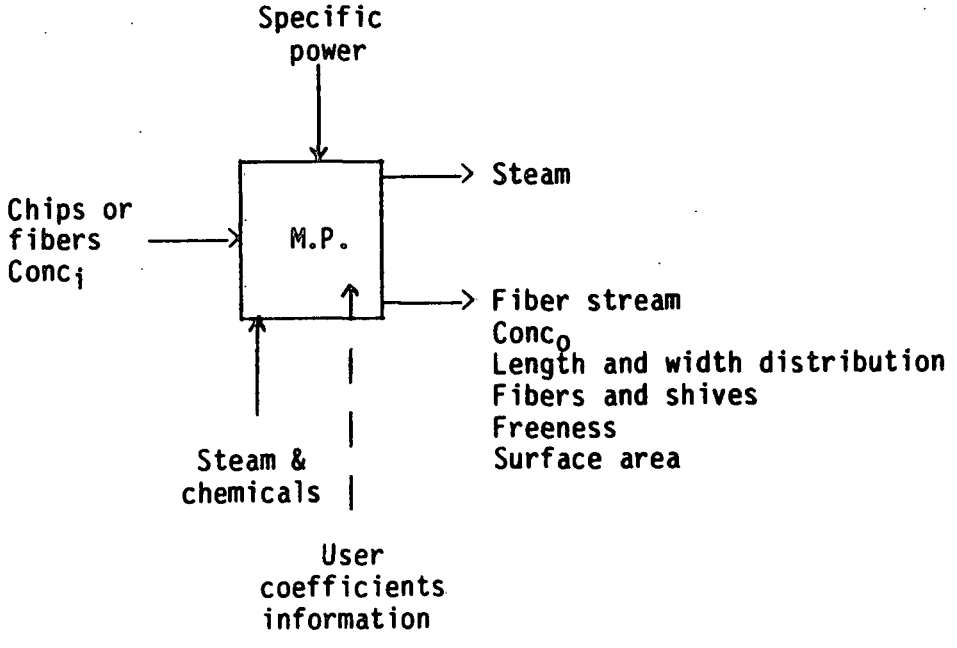
$$P = a + b\, S_t^{0.425}$$

a, b functions of

- wood type
- CSF

SUMMARY

- Multiple sources required
- Substantial testing required



- GW, RMP, TMP, CMP, CTMP

CONVERGENCE ACCELERATION OF MAPPS

- Direct substitution
  - $\bar{x}_{i+1} = \bar{x}_i$
  - currently used
  - very stable
  - can be slow
- Improved methods under development

- John McKibben - A190
- Wegstein

  Modified 1-D second method

  $$\bar{x}_{i+1} = q\,\bar{x}_i + (1 - q)\,f(\bar{x}_i)$$

  $$\frac{-q}{q+1} = a = \frac{f(\bar{x}_i) - f(\bar{x}_{i-1})}{\bar{x}_1 - \bar{x}_{i-1}}$$

  $-2 < a < 0$

  Implemented, undergoing testing

Broyden

Modified Newton's Method

$$\bar{x}_{i+1} = \bar{x}_i + \bar{\bar{H}}_i \, f(\bar{x}_i)$$

$$\bar{\bar{H}}_{i+1} = \bar{\bar{H}}_i - \frac{(\bar{p}_i + \bar{\bar{H}}_i \, \bar{y}_i) \, \bar{p}_i^T \bar{\bar{H}}_i}{\bar{p}_i^T \bar{\bar{H}}_i \bar{y}_i}$$

$$\bar{y}_i = f(\bar{x}_{i+1}) - f(\bar{x}_i)$$

$$\bar{p}_i = \bar{x}_{i+1} - \bar{x}_i$$

MULTIPLE EFFECT EVAPORATOR MODULE FOR MAPPS

- Greg Vottsmier - A190
- Current "multiple-effect" module (EVAPØ1) oversimplified
- Single effect module developed (EVAPØ2)
  - works well
  - slow to converge in some cases
- New module under development
  - simultaneous heat and material balance equations
  - implement sparce equation solving techniques
  - cocurrent, countercurrent, split feed
  - design or simulation modes

QUALITY MODELING GOALS

PROVIDE STRUCTURE FOR COMPUTING AND TRACKING QUALITY ATTRIBUTES

ALLOW USERS FLEXIBILITY IN DEFINING QUALITY ATTRIBUTES

ALLOW EXISTING DATA DECKS TO RUN WITHOUT MODIFICATION

MINIMIZE IMPACT ON EXISTING CODE

QUALITY STREAM IMPLEMENTATION

FOR EACH MATERIAL STREAM, THERE EXISTS A QUALITY STREAM

QUALITY STREAMS CAN HAVE UP TO 10 ATTRIBUTES

QUALITY STREAM DEFINITIONS RESIDE IN STREAM TABLE

TOTAL NUMBER OF QUALITY ATTRIBUTES IN A SIMULATION LIMITED TO SOME LARGE NUMBERS

- STORED AS MODULE PARAMETERS
- ACCESSED AS STREAM INFORMATION

QUALITY STREAM IMPLEMENTATION

DEFINE QUALITY ATTRIBUTES SAME AS
ALL OTHER STREAM ATTRIBUTES

300 VISCOSITY
301 BRIGHTNESS
302 TEAR
. .
. .
. .

BUILD DEFINITION FROM LIST OF
ALLOWABLE ATTRIBUTES

PAPER (MATERIAL)	PAPER (QUALITY)
NO.	NO.
TYPE	ATTRIBUTE 1
TEMP	ATTRIBUTE 2
.	.
.	.
.	.

QUALITY STREAM IMPLEMENTATION

QUALITY DEFINITIONS DEFINABLE
ONLY THROUGH STREAM TABLE

USER CANNOT DYNAMICALLY REDEFINE
QUALITY ATTRIBUTES

SYSTEM IMPLEMENTATION

EXECUTIVE MOVES ATTRIBUTE VALUES FROM MASTER STORAGE TO WORKING STORAGE

MODULE ACCEPTS INPUT QUALITY STREAM QUALITY ATTRIBUTES AND COMPUTES OUTPUT STREAM QUALITY ATTRIBUTES

EXECUTIVE STORES OUTPUT ATTRIBUTES FROM WORKING STORAGE TO MASTER STORAGE

EDITOR "WRITE" COMMANDS MODIFIED TO HANDLE QUALITY ATTRIBUTES

CONTROLLERS MODIFIED TO MANIPULATE QUALITY ATTRIBUTES

QUALITY MODELING IMPLEMENTATION

AS KNOWLEDGE BECOMES AVAILABLE, WE WILL DEVELOP APPROPRIATE MODELS

STRUCTURE IS FLEXIBLE TO ENCOURAGE USERS TO DEVELOP OWN MODELS

CONSIDERING IMPACT ON PHYSICAL PROPERTY DATABASE NEEDS

DISTINCTION BETWEEN PHYSICAL PROPERTIES AND QUALITY ATTRIBUTES IS UNCLEAR IN SOME AREAS